

Controlled Hierarchical Structure Additive Manufacturing

Completed Technology Project (2016 - 2017)



Project Introduction

Additive manufacturing methods (e.g. direct-write, stereolithography (SLA), etc.) will be used to place living organisms (e.g. bacteria, diatoms, etc.) at desired locations for use as templates for nanoscale geometric and material property control. Current efforts to additively manufacture hierarchical structures focus on commercially available machines and are limited by the resolution of those machines, while work on bio-inspired materials consists using organisms to create the printing materials. Bioprinting efforts look into using additive manufacturing to place organisms or cell in desired locations to create new biological systems, but no efforts to date have utilized bioprinting to yield synthetic materials.

Anticipated Benefits

Hierarchical structures display unique mechanical properties such as high specific strength and fracture toughness due to their complex geometry and tunable material properties at the nanoscale. These structures are commonly found in nature, but are difficult to produce and control with synthetic materials in large (meter scale) objects. Additive manufacturing has been recognized as a promising solution for creating hierarchical structures because of its ability to create complex geometries while placing multiple materials at desired locations. However, as with other manufacturing methods there is a trade-off between printing resolution and overall part size. High resolution AM methods cannot produce large objects (meter scale) and vice versa. Therefore, to enable additive manufacturing of hierarchical structures there is a need for a process that can direct and control the nanoscale to macroscale geometry and properties of a printed object. The aim of this work is to create complex hierarchical features using a combination of additive manufacturing and biological processes to print the macrostructure and grow the nanostructure



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Table of Contents

Project Introduction	1
Anticipated Benefits	1
Organizational Responsibility	1
Primary U.S. Work Locations and Key Partners	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	2
Target Destination	2

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

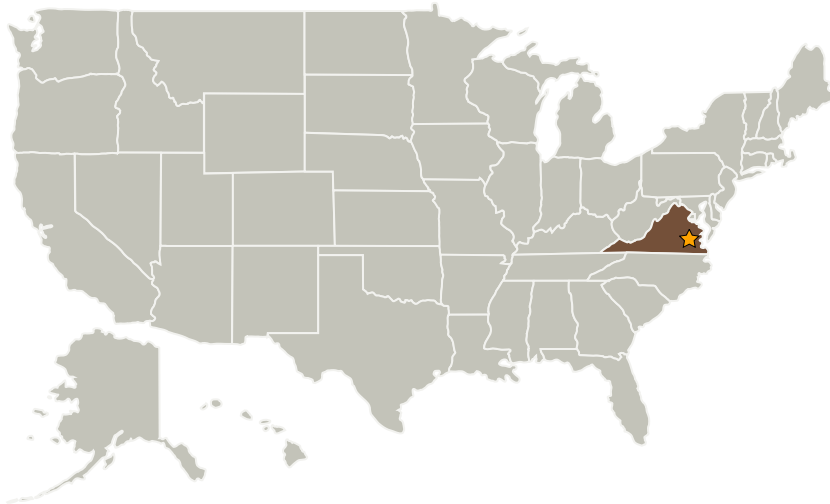
Center Innovation Fund: LaRC CIF

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Langley Research Center (LaRC)	Lead Organization	NASA Center	Hampton, Virginia
William & Mary	Supporting Organization	Academia	Williamsburg, Virginia

Primary U.S. Work Locations

Virginia

Project Management

Program Director:

Michael R Lapointe

Program Manager:

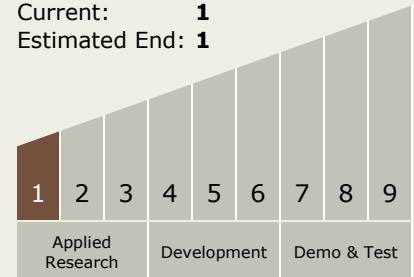
Julie A Williams-byrd

Principal Investigator:

John M Gardner

Technology Maturity (TRL)

Start: **1**
 Current: **1**
 Estimated End: **1**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.4 Manufacturing
 - └ TX12.4.2 Intelligent Integrated Manufacturing

Target Destination

Foundational Knowledge